SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

C.] MAY, 1874. [PRICE FOURPENCE, or5s. *per ann. post free.*]

CONCERNING ANEMOMETERS AND THE REAL FORCE OF THE WIND.

WE do not aim in this article at any higher object than that of stringing together sundry thoughts which have doubtless occurred to others as well as to ourselves, and indicating certain points which we think ought to be ascertained without further delay. While we have no desire that anyone who has an anemometer at work should neglect to record it, we hold that of the many thousands of pounds expended in the purchase and erection of anemometers, a very large proportion has been absolutely wasted. This is a strong statement; let us give a few reasons in its support.

What is a proper position for an anemometer? Can anyone answer that question? Shall we take the positions in which they have been placed by eminent meteorologists as our guide and answer? If so, we fear the answers are so contradictory as to amount to little more than a general rule that they should be up among, and slightly above, the chimney-pots, on a building of any shape, and at any height above the ground.

We think that these points are all wrong. Chimney-pots imply three objectionable features—(1) their presence, even below the level of the cups, must disturb the regular flow of the air, like "snags" in a river; (2) chimneys usually imply smoke, and anemometers, under the most favourable conditions, require very frequent cleansing and oiling; soot and oil jointly make a glutinous compound, with which we have seen an anemometer coated half-an-inch thick; (3) chimneys imply usually the discharge of currents of heated air, scarcely likely to seriously affect the readings, but not conducive to their accuracy.

The shape of a building on which an anemometer is placed cannot be unimportant, although we are not aware that anyone has attempted to ascertain what effect it produces; yet we hold that if anemometers are to be placed upon house and observatory roofs, it is beginning at the wrong end to compare the results of different stations one with another until we know the "personal error," if it may be so termed, of the position of each instrument.

Then as to height above ground, the variety is nearly as great as in the positions of the instruments, and the shape of the buildings; and yet there cannot be a shadow of doubt that the velocity of the wind increases with every foot of elevation above the ground. The friction of the air against the surface of the earth is very great. We have heard of two anemometers, one with its cups 2 ft. above a grass field, and the other mounted on an isolated pole 20 ft. high, and that the upper one recorded something like seven times the wind that the lower one did. Again, was anyone ever in the golden gallery of St. Paul's when there was a calm at that elevation? or we may quote the many miles which a balloon will be carried while the anemometers are scarcely turning.

Before proceeding to other branches of the subject, we may perhaps answer in anticipation the possible remark, "It would be quite as well if in addition to pointing out the defects of what has been done, you would state how you would avoid these difficulties." We have no desire to shirk this perfectly legitimate criticism. We believe that no anemometer should ever be placed on or near any house or observatory, but that some definite height (not less than 20 ft.) should be agreed upon for the elevation of the cups (if a cup anemometer be used) above the ground; and that they should be raised to that height by some framing which should be arranged to give the greatest rigidity at the same time that it presents the least possible surface to disturb the even flow of the wind, and this erection should be in a level open field, at least a hundred yards from any trees.

Previous to deciding upon the height to be adopted, and really the sooner the better, if our observations are to be of practical utility, a series of instruments must be erected on isolated poles in some very open place, at heights ranging from 1 or 2 ft. to the greatest which may be found practicable, perhaps somewhat as follows:—2, 10, 20, 40, 60 ft. Five anemometers thus mounted would, we believe, be of more real use than any dozen now at work.

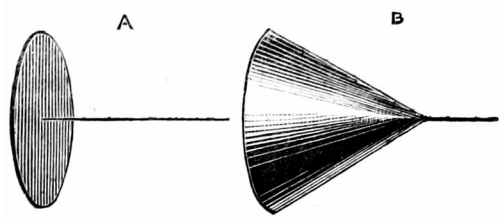
There is another point of which no observations are made, and none worth recording could be made on any existing observatory. We refer to the inclination of the wind. We suppose no one who ever thought much about it believes that the wind always, or even generally, blows exactly level; and if it does not, what becomes of pressure anemometers whose plates are always so set as to act against an absolutely horizontal wind? Evidently, whenever the wind has an upward or downward tendency, these plates must indicate less than the truth. We believe that one instrument intended for the determination of this element is still in existence at Nottingham, but we are not aware that any results have been published. Some ten years since the British Association granted to Prof. Hennessey two sums of £13 and £20 respectively for the construction of apparatus to test this question, but we cannot find that even "progress" was ever reported.

We are extremely glad to hear that the experiments made many years since by Mr. Glaisher have lately been repeated in a modified

form under the direction, we believe, of the Meteorological Committee. We expect our opticians to do much for us, and are not disappointed, but there are some things which it is not reasonable to expect, and one of them is, that they should test all the anemometers they sell. There are two reasons against it, but as one is fatal, the other need not be mentioned. The fatal one is, that the testing could not possibly be carried out properly in the heart of a busy city. Indeed, it is not easy to test anemometers even in the open country, for if they are near enough to be in the same current they will mutually influence their readings. Mr. Glaisher's experiments were, we believe, made by attaching an anemometer to the end of a long arm, rotated horizontally by manual power; those recently conducted consisted in attaching outriggers to a very large "merry-go-round," driven by steam, so that the anemometers were on radii of a circle of about 50 ft. in diameter. This could be rotated at such a velocity that the cups were driven at we should think thirty miles an hour, and as the distance travelled was of course known accurately, the results when published will be of considerable importance.

There are several other points to which we desire to call attention, but they must be dismissed more briefly. We do not think that the indications of the barometer have been sufficiently attended to, when attempts have been made to compare the records of pressure and velocity of anemometers. It is probably true that the effect of different barometric pressures is not sufficient to account for the apparently hopeless irreconcilability of the two classes of instruments. Still, it must not be forgotten that with an ordinary English cyclone the barometer will not infrequently be at 28 inches with a S.S.E. wind, and considerably above 30 with one from N.E. Evidently with the barometer at 28 inches, the density of the air is one-fifteenth less than when it is at 30 inches, and, therefore, the pressure exerted by a wind of any velocity will be one-fifteenth (say 7 per cent.) less than with the higher barometer.

Mr. Cator in his anemometer has avoided one great evil of pressure instruments—viz., the deterioration of springs, for he has done away with them entirely. But he has introduced a new principle, which either he or some of our authorities should first have tested. Hitherto all the surfaces exposed for the purpose of receiving the pressure have been plane metal surfaces, like Fig A. Mr. Cator, however, has backed



his plate with a cone, as in Fig. B. We think that these two forms should be strictly compared.

The best proportion for cups was, we believe, approximately determined by Mr. Stow, but the best size for pressure plates is unknown.

Again, there is the very important question of the relative merits of vanes and fans for keeping the plates at right angles to the direction of the wind. We need hardly remind our readers that it is absolutely essential to the accurate measurement of pressure that the surface acted upon should be exactly perpendicular to the direction of the wind acting upon it. We have already stated that this is not provided for with reference to a vertical plane, and that the force of all except absolutely horizontal winds is understated. At least equal inaccuracy prevails with reference to direction, for it is obvious that, except when a high pressure occurs from exactly the point of the compass to which the vane is pointing, it is improbable that the vane will bring the pressure plate exactly to the right azimuth at the instant of greatest pressure, and if it does not, then again the wind acts obliquely upon the pressure plate. This evil may be produced quite as much by excessive facility of motion in the vane as by its sluggishness, for it will be as likely to produce error if the vane carry the plate too far as if it do not carry it far enough. For this reason an attempt was made to substitute a fan, or "windmill-governor," but we believe it was not regarded as satisfactory. We should like to see a simultaneous comparison of plates governed by the two methods.

In concluding these unconnected notes, we desire to express the hope that for the future the directors of leading observatories will not make attempts to improve the instruments under their care, but that somewhere, and by some body of experienced men (probably Kew is in all respects most suitable), all experiments should be tried. The former will render the records of our observatories available for comparison as regards secular questions. At present, with few exceptions, it is as useless to compare the records of one set of years with another as it is to compare those of different positions.

The latter proposal we think of extreme importance—far more than that of erecting instruments in fresh localities, for we should not only obtain the means of having all anemometers *properly* tested before erection, but we should also have a centre where all rational ideas upon the subject might be impartially examined, and where a store both of instruments and experience would soon be gathered, whence might finally be evolved an instrument which should be sound in principle and suitable for universal use. When this has been done, we trust it would be unanimously accepted, that very stringent rules would be framed for its mounting and management, descending even to the minutiæ of cleaning and the kind of oil to be used, and then we should have that which at present seems so distant—comparable anemometric observations.

INDIAN METEOROLOGY IN PARLIAMENT.

We are very glad to see that this extremely important subject has been taken up by Mr. Egerton Hubbard, who brought it forward on

May 8th, in a short speech which commanded the attention of the House, and in response to which Lord G. Hamilton agreed to produce all the despatches moved for, and added that Lord Northbrook intended to give full consideration to it, and to organize a complete system of meteorological registration.

We believe that the following may be regarded as an accurate report of the remarks upon the subject.

Mr. E. Hubbard rose to call the attention of the House to page 30 of the "Abstract of Report of Surveys in India," in which it was stated that "the question of the organization of a Meteorological department in India is still under consideration—the despatch from the Secretary of State on the subject, dated the 18th May, 1871, and enclosing the report of the committee of the Royal Society, not having yet been answered." The hon. member asked the Under Secretary of State for India, whether he would have any objection to laying upon the table all despatches which had passed to and from the Government of India upon the subject during the last five years. He stated that his own attention was first directed to the matter by a letter which appeared on November 3rd, 1873, in the *Daily News*—a paper to which the country was indebted for most talented criticisms in relation to the famine in India (hear, hear). The hon. member referred to the present state of meteorology in India, and to the advantages which would result from a knowledge of the rainfall, and of the temperature of different parts of the country; pointed out how much the officials in India were indebted to Meteorology for indications as to the present famine, and how important it was that India should have a good meteorological department. He expressed the hope that the Under Secretary of State would cause additional Blue books on this subject to be printed, seeing that the only information which the public could obtain was from the works of Mr. Clements Markham, the distinguished secretary of the Royal Geographical Society. The hon. member concluded by moving for all the despatches on this subject to and from the Indian Government during the last five years.

Lord G. Hamilton said that he had no objection to laying upon the table the despatches for which the hon. member had moved. Lord Northbrook had stated recently that he intended to give full consideration to the question of organizing a complete system of meteorological registration, and there was reason to believe that provision had been made for the necessary expenditure, in the Indian estimates for 1874-5 (hear, hear).

Those of our readers who are acquainted with the state of Indian meteorology will agree with us that nothing could have been more felicitous than the above brief remarks. We trust that few, if any, more years will elapse before this great subject is finally decided; and several remarks in the recent papers prepared for the Indian office by Mr. Markham, gives us every reason to confidently expect such an issue. We refer to such paragraphs as the two following:—

"Indian administrators are beginning to be impressed with the great impor-

tance of meteorological observations to agriculture; and a general system of inter-comparable registration is being introduced."

"The Lieutenant-Governor of Bengal is impressed with the connection between meteorological registration and agriculture, and considers that there is much scope for enquiry as to the effect of peculiar climatic conditions on health, and on the crops. Little is known of the course of the monsoons, of the circumstances under which the summer rainfall is thrown sometimes on the East, sometimes on the West of the Bay of Bengal, is sometimes abundant in Bengal and scanty in the North-west provinces, and sometimes, as in 1872, almost deserts Bengal and falls in Northern India. The questions whether the rainfall of Northern India is more connected with rain-bearing winds coming from Bengal and deflected by the Himalayas, or with those coming up from Western India, and whether the S.E. winds in Bengal, towards the end of the rainy season, and in October, have any connection with the currents which cause the N.E. monsoon falling on the S.W. coast of the Bay of Bengal, will be solved by the efforts of Meteorologists, with data carefully registered over a series of years. Mr. Blandford is already able to give a tolerably complete notion of the general barometric pressure over Northern India, throughout the year, as well as of the distribution of the mean temperature, deduced from observations extending over four years. The annual changes in temperature appear to correspond in general with the distribution and changes of mean pressure; the areas of low temperature coinciding with those of high pressure. As these investigations advance, light will also be thrown on the normal law of the monsoons and of their anomalies, with respect to the distribution of rainfall, and its variation in different years; and eventually a very much more complete knowledge will be acquired of laws, which, in their influence on the crops, have a direct bearing on the well-being of the people."

Any one who doubts the necessity of the prompt adoption of some well-considered scheme for the utilization of present and past work, for avoiding superfluous observations in the future, need only carefully read Mr. Markham's capital article on "Meteorological and Tidal Observations," which we may, *en passant*, quote as a very exhaustive, and to meteorologists, indispensable summary of the bibliography and history of meteorology for nearly a hundred years, as well as an accurate record of matters as they stood in 1870. While we estimate highly what has been done, and is still continued by Messrs. Blandford, Chambers, Pogson, and others, and trust that every encouragement will be extended to them, we certainly do think it most desirable that all the systems of meteorological registration in India should be brought into absolute uniformity under some one individual or body. At the same time, it is equally necessary not to bury the individuality of such men as those above-mentioned.

The observations must be made with absolute identity, and the results must be uniformly worked out and printed, but at the same time it is most desirable that the country should still have the advantage of the individual and personal views of the gentlemen in local charge of the various systems. The public require (1) absolutely comparable data from all parts of India; (2) results deduced from these data by the most able men whose services it is possible to enlist; (3) that these publications be not under any circumstances allowed to fall in arrear.

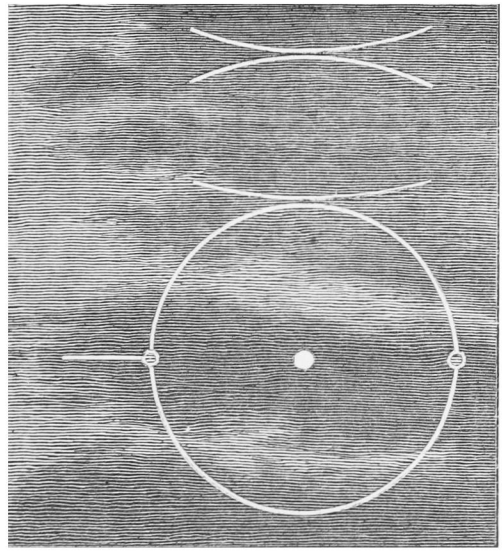
From Mr. Hubbard's question it appears that the Meteorological Committee have been consulted as to the organization suitable for India, and it would seem that their report will be among the papers which Lord G. Hamilton has promised. We shall look for it with considerable interest, and return to the subject after its perusal.

CLOUDS, PARHELIA, &c., ON MAY 1st.

To the Editor of the Meteorological Magazine.

SIR,—I jot down the following notes in the hope that they will prove of interest to some of your readers. I do not think that many meteorological observers have often seen fine examples of parhelia, or mock suns. Certainly, although I have been in the habit of watching the sky with some care for ten years, I have never been fortunate enough to see such phenomena before this month.

About 5 p.m. I was sitting near a west window watching the operations of a queen wasp in my garden, when I chanced to look skyward. A bright prismatic fringe lay on a cloud in the S.W. at an altitude of some 30°. On going outside I readily made out the complete solar halo of about 22° radius, the lower portion being extremely faint. At each of the opposite points where the horizontal diameter cut the halo there was a mock sun: they were much less bright than the real sun, smaller, and very ill-defined. About 60° above the sun's centre there was a coloured arc (the red towards the sun), perhaps 40° degrees in length, its centre being near the zenith. In contact with the lowest point of this there was another coloured arc, having the sun for its centre. Lower down, and in contact with the first-named halo, there



was also a coloured arc, with its centre above, and this arc also was about 40° in length. The southern mock sun was much brighter than that towards the north, and in no part of the halo was the colour so fine as near these suns. A bright white beam shot out some 10° beyond the southern mock sun. The thin clouds which prevailed in the west were hidden about 5.45 p.m. by dense white clouds at a lower level brought over by the N.E. wind.

At 8 a.m. to-day the clouds nearest the earth's surface were moving

from the N.E.; higher there was a stratum of cloud moving from the N.W.

At 7 p.m. long lines of beautiful white fibrous clouds lay across the sky from N.W. to S.E., diverging from both points to the zenith. The fibres of which they were composed lay at right angles to the length of the clouds. The fibrous structure soon gave way to small closely-packed cirro-cumuli. These clouds were all moving slowly from N.W. to S.E. Traces of similarly disposed clouds could be seen in the full moonlight about 11.30 p.m.

Yours very truly,

JOSEPH GLEDHILL, F.G.S., &c.

P.S.—Halos were seen on twelve days in April last.

MEASUREMENT OF SNOW.

To the Editor of the Meteorological Magazine.

SIR,—Having had some experience in the management of rain gauges, and knowing that snow measurements are interesting to you and your readers, I thought it worth my while to make, as far as I was able, a note of the fall of rain and snow during the winter months at this place. I have taken much trouble with it, and the measurements are strictly accurate.

In my letter last month on the climate of this place, I mentioned that I had two gauges at work; one (termed in Table, rain gauge), an ordinary rain gauge, a copper cylinder; the other (termed snow gauge), an iron japanned cylinder. Both have funnels 5 in. diameter, 4 in. deep, but the copper one has only a rim half-inch deep, the iron one has a perpendicular rim 6 in. deep before the funnel commences. For the glass bottles sent with them as receivers I substituted tin ones, as glass would not have stood the frost here for a moment. The rims of the gauges were perfectly level with each other, 18 in. from the ground, and 9 in. apart from each other.

I do not give the exact dates of fall, as I measured at all times, when possible, the moment the snow ceased for the time, to avoid chance of evaporation. I have endeavoured to give the direction of the wind as far as, in this still air, I could ascertain it from the movement of the clouds during the fall, but, unless otherwise specified in the remarks, the fall was in fact in a calm.

The snow *usually* falls here in the finest and most minute crystals. This led me to make further experiments, viz., 1st, with the light crystal snow, No. 1, in Table III.; 2ndly, denser snow, falling in large flakes, No. 2; and 3rdly, snow which had lain upon the ground a day or two with a hot sun upon it, No. 3. The average yield of water from a depth of 3 in. of snow in each case (taking the mean of the ten measurements) was, in the 1st case, ·224; 2nd, ·299; 3rd, ·742. This last is, probably, of no value, but as I made the observation I insert it. These measurements were made by inverting snow gauge funnel in the snow, slipping a piece of zinc underneath, placing the snow in so many covered cups, melting in a warm room, and then

measuring. I may add that all measurements in the tables were made with the same measuring glass.

TABLE III.—10 *Measurements with inverted funnel of* 3 *inches of Snow.*

	1	2	3
	Snow in fine Crystals.	Snow in large Flakes.	Old Snow.
	in.	in.	in.
	·220	·310	·770
	·225	·260	·750
	·220	·280	·730
	·223	·320	·720
	·227	·310	·780
	·228	·305	·750
	·220	·297	·735
	·229	·298	·725
	·233	·300	·740
	·225	·310	·720
Means	·224	·299	·742

The measurements, however, in Table II., were made by bringing the funnels into a warm room, covering the funnel, and placing the pipe in the measuring glass. Measuring by inverting the funnel is not satisfactory, because, unless the weather be very cold, the snow invariably melts for a short time before it begins to lie.

TABLE II.—*Total of Measured Snow.*

Snow Gauge.	Rain Gauge.	Measure.	Depth.
in.	in.	in.	in.
·100	·100	·080	1
1·130	·900	·600	6
·610	·420	·420	5
·570	·310	·500	7
·500	·200	·500	6
·450	·300	·430	5
·230	·120	·225	3
·250	·230	·230	3
·310	·200	·310	5
·130	·130	·130	2¼
·200	·150	·180	3
·210	·200	·210	3
·440	·440	·430	5
·722	·722	·652	7
5·852	4·422	4·897	61¼

I think it may fairly be inferred from the tables that a deep rim of 6 or even 8 in. would be an advantage to all gauges, and save the trouble I frequently have experienced of going out after dark to put down the snow gauge when snow has unexpectedly come on. In calm rainy weather, and when snow is not too deep for the rain gauge, both

TABLE I.

Date.	Snow Gauge. 5 in.	Rain Gauge. 5 in.	Measurement with Funnel inverted.	Depth in Inches.	Direction of Wind.	Force. 0-10	REMARKS.
	in.	in.	in.				
Oct. ...	0·430	0·430	...	...	S.W.	1	Steady R.
	·635	·635	...	..	,,	1	do.
	·010	·010	...	...	N.E.	2	A shower.
	·320	·320	...	...	W.	1	S and R.
	·610	·600	...	...	,,	1	S and sleet.
	·020	·020	...	...	,,	1	do.
	·070	·060	...	...	S.W.	1	S and R turning to S.
Nov ..	·420	·420	...	...	W.	1	R.
	·400	·400	...	...	,,	2	R.
	·700	·630	...	...	,,	7	*High wind*, S and R.
	·180	·180	...	..	,,	1	R.
	1·720	1·720	...	...	N.W.	2	R, S, sleet.
	·100	·100	·080	1	W.	1	S.
	1·130	·900	·600	6	N.W.	8	TS 4 a.m., with *gale* and heavy R turning to S.
Dec....	·110	·090	...	...	,,	4	*High wind*, sleet.
	·390	·390	...	..	N.E.	1	R, freezing as it fell.
	·610	·420	·420	5	,,	9	*Violent gale*, S.
Jan. ...	‡·570	·310	·500	7	,,	7	*High wind*, R turning to S.
	·015	·010	...	...	,,	3	Slight S, melting in sun as it fell.
	·500	* ·200	·500	6	,,	2	4 hours' S.
	·015	·015	...	...	,,	1	R.
	·010	·010	...	...	Calm	0	Slight S, melting as it fell.
Feb. ...	·050	·050	...	...	,,	0	do. do.
	·450	* ·300	·430	5	,,	0	S in fine crystals.
Mar....	·050	·050	...	...	S.W.	1	R.
	·070	·070	...	...	Calm	0	S and R.
	·230	·120	·225	3	S.W.	6	*High wind*, 3 hours' S in fine crystals.
	·250	·230	·230	3	,,	3	3 hours' S in fine crystals.
	·310	* ·200	·310	5	W.	1	S during night.
	·130	·130	·130	2¼	N.E.	1	Steady fine crystal S.
	·200	·150	·180	3	,,	1	do. *Strong wind for* 1 *hour.*
	·210	·200	·210	3	,,	1	S in night.
	·070	·070	...	...	N.	4	R.
	·145	·145	...	...	,,	3	Showers of S and R.
	·040	·040	...	...	N.W.	4	do.
	·035	·035	..	...	N.	1	R.
	·270	·270	...	...	N.	2	R.
	·230	·230	...	..	N.W.	1	R.
April..	·020	·020	...	...	S.W.	6	3 hours' S and sleet.
	·440	·440	·430	5	Calm	0	8 hours' heavy S in enormous flakes, melting in gauges as it fell, but lying on old S and grass.
	·070	·070	...	...	,,	0	3 hours' S and sleet.
	·040	·040	...	...	,,	0	3 hours' small S.
April 5	·722	·722	·652	7	,,	0	23 hours' S, melting in gauges as it fell, and lying after a time on grass.
	12·997	11·452	4·897	61¼			

* Gauge unable to hold the depth.

have worked together, but when snow falls *with wind*, and when it is a deep fall, the rain gauge does not catch what it ought. On the 4th January (marked in Table I. with a ‡), when the snow fell during a violent gale, I watched the two gauges for a very long time, and it was long before the rain gauge caught anything, the snow whirling round the funnel and out again—not so the gauge with the 6 in. rim. I do not think a single flake fairly in ever came out again. The fall began with heavy rain, and the result was as seen in table :—snow gauge, 0·570 ; rain gauge, 0·310 ; measurement of 7 in. depth, 0·500.

I cannot close this without mentioning an extraordinary change of temperature within the last few days. Friday, 3rd, there was a brilliant sun, heat intense, 74° in shade ; the fields covered with flowers, snowdrops, crocus, gentian, soldanella, and numberless others. At 10 p.m. thermometer stood at 63° ; at 4 a.m.; 4th, thermometer at 32°, with heavy snow, which has continued almost without interruption till 5 a.m. this morning. From 6 a.m. on Easter Sunday it never ceased for twenty-three hours; at the time I am writing, noon, the thermometer is 58°, and snow, nearly a foot deep at 9 a.m., is gone.

I am, Sir, truly yours, MICHAEL FOSTER WARD, F.M.S.

Rossinière, Canton Vaud, Switzerland, 6th April, 1874.

Meteorological Register taken at Mentone (Western Bay), Alpes Maritimes, France.

	January		February.		March.		April.	
Barometer—								
Highest reading	30·362e	22nd	30·432m	13th	30·365m	5th	30·190e	22nd
Lowest ,,	29·637m	18th	29·623e	17th	29·505m	11th	29·113m	14th
Hygrometer—								
Mean of degrees of dryness	2·38	..	4·30	..	4·70	...	4·21	...
Thermometer—								
Mean max. 4ft..	61·7	...	61·7	...	67·3	...	72·2	..
Absolute max...	68·8	31st	72·6	1st	74·8	1st	85·8	25th
Mean min.....	36·0	...	36·9	...	38·4	...	47·7	...
Absolute min...	27·6	7th	23·6	11th	29·6	13th	42·1	11th
Mean min. 6in. above ground.	34·9	...	35·9	...	37·5	...	46·9	...
Absolute min. ,,	25·8	7th	22·2	11th	27·5	13th	41·0	13th, 16th
Rainfall—								
Total amount...	1·714	...	1·662	...	·570	...	6·270	...
Greatest in 24 hours	1·245	16th	·852	15th	·302	9th	2·350	4th
No. of days on which ·001 fell	4 days	...	4 days	...	3 days	...	7 days	...
Cloud—								
Mean amount...	3·8	...	4·9	...	3·6	...	5·4	...
No. of cloudless days.....	8 days	...	7 days	...	5 days	...	5 days	...

PHILIP WRIGHT. F.C.S.

APRIL, 1874.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·26	+ ·13	·33	9	11	79·2	23	32·7	11	0	4
II.		Maidstone (Linton Park)	1·91	+ ·69	·68	10	10	80·0	21*	30·0	1	7	...
,,		Selborne (The Wakes)	2·93	+ 1·43	1·23	4	10	73·0	27	27·5	30	2	7
III.		Hitchen	1·84	+ ·84	·80	4	12	68·0	21	31·0	10‡	4	...
,,		Banbury	1·43	+ ·27	·50	9	12	73·5	21	29·0	13	3	...
IV.		Bury St. Edmunds (Culford)	·69	— ·06	·27	8	9	74·0	21	24·0	29	5	11
V.		Bridport	1·82	+ ·34	·47	4	12	73·0	26	29·0	6	4	...
,,		Barnstaple	1·89	— ·12	·46	3	11	79·0	28	35·0	11	...	..
,,		Bodmin	2·56	+ ·86	·47	8	17	72·0	25	34·0	11	0	0
VI.		Cirencester	1·59	+ ·30	·48	9	12	...	...	...	...	...	...
,,		Shiffnal (Haughton Hall)	1·17	+ ·02	·44	2	13	71·0	26	30·0	11§	6	11
,,		Tenbury (Orleton)	1·59	+ ·05	·42	2	13	76·0	21	29·2	11	7	8
VII.		Leicester (Wigston)	1·22	— ·08	·46	9	10	80·0	21*	31·0	10‡	4	...
,,		Boston	·46	— ·51	·15	13	8	76·0	21**	33·0	11	...	...
,,		Grimsby (Killingholme)	·91	...	·32	9	8	72·0	21	34·0	6,11	0	...
,,		Derby	1·26	— ·17	·45	9	11	75·0	21	31·0	11	1	...
VIII.		Manchester	1·00	— ·76	·27	2	15	80·5	26	29·0	13	2	7
IX.		York	1·28	+ ·18	·33	13	8	72·5	21	33·0	9‖	0	...
,,		Skipton (Arncliffe)	2·95	— ·09	1·30	2	14	...	...	...	...	...	...
X.		North Shields	·72	— ·59	·29	13	11	71·5	21	33·4	12	0	0
,,		Borrowdale (Seathwaite)	4·72	— 2·18	1·08	8	19	...	...	...	...	.	...
XI.	WALES.	Cardiff (Ely)	1·80	— ·13	·25	13	12	...	...	...	...	...	...
,,		Haverfordwest	2·34	+ ·48	·40	8	14	74·1	27	32·2	26	...	9
,,		Rhayader (Cefnfaes)	2·06	+ ·17	·56	17	16	75·0	...	29·0	...	...	...
,,		Llandudno	1·41	— ·09	·47	2	12	81·0	27	35·3	11	...	...
XII.	SCOTLAND.	Dumfries	2·12	+ ·45	·67	2	15	74·0	27	30·5	13	3	9
,,		Hawick (Silverbut Hall)	1·95	...	1·08	2	11	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	1·29	...	·42	2	15	72·5	27	32·5	12	0	5
XV.		Castle Toward	2·94	+ ·44	·62	11	16	71·0	26	...	...	0	0
XVI.		Leven (Nookton)	1·46	+ ·21	·47	2	15	69·0	21	27·0	11	5	19
,,		Stirling (Deanston)	...	...	..	...	...	..	...	...	...	...	...
,,		Logierait	1·25	...	·26	1	12	74·0	29	31·0	1¶	...	...
XVII.		Braemar	2·42	+ 1·02	·80	1	16	68·0	29	25·0	23	5	23
,,		Aberdeen	·98	...	·21	15	12	66·6	22	32·5	12	0	12
XVIII		Portree	5·88	+ ·61	·93	4	24	...	...	...	...	...	...
,,		Loch Broom	4·69	...	1·21	4	21	...	...	...	...	...	...
,,		Inverness (Culloden)	1·60	+ ·13	·25	3	14	62·2	28	31·5	23	1	16
XIX.		Helmsdale	2·91	...	·58	20	20	...	...	...	...	...	...
,,		Sandwick	2·10	+ ·36	·42	2	19	56·5	29	35·4	4	0	2
XX.	IRELAND.	Caherciveen Darrynane Abbey	3·26	...	·47	12	18	...	...	...	...	...	..
,,		Cork	1·28	...	·48	12	9	...	...	...	...	...	...
,,		Waterford	2·61	+ ·38	·54	7	17	64·0	19*	32·0	11	1	...
,,		Killaloe	3·46	+ 1·33	·50	2,12	18	75·0	27	28·0	11	5	12
XXI.		Portarlington	1·61	— ·41	·28	3	20	70·0	28	29·5	10	2	...
,,		Monkstown, Dublin	1·11	— ·53	·25	12	12	74·0	27†	28·0	11	3	...
XXII.		Galway	3·07	...	·53	1	19	77·0	29	31·0	12	2	...
,,		Ballyshannon	3·03	...	·65	2	23	58·0	26*	32·0	4	1	...
XXIII		Waringstown	1·41	...	·26	12	13	76·0	27	28·0	11	7	10
,,		Edenfell (Omagh)	2·45	...	.33	2,7	21	69·0	26*	27·0	11	7	...

* And 27. † 28. ‡ 12. § 13. ‖ 11, 13. ¶ 6, 11. ** And 23.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON APRIL.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail: S or Snow.

ENGLAND.

CAMDEN TOWN.—Very heavy H for a short time, commencing noon, on the 11th.

LINTON PARK.—The beginning of the month not remarkable; heavy rain on 10th and 12th, but none after the 14th, the last 16 days being very dry and fine, in fact, often as hot as June, so that vegetation made great progress, the hawthorn being in bloom on the 27th, which is earlier than I have any record of, except in 1857 and 1868. Nightingale heard on 19th, and the cuckoo on the 20th, which is later than the average for both. High wind on 2nd and 3rd, and slight frosts on 1st, 4th, 6th, 7th, 9th, 11th and 30th. Bar. generally high and steady; altogether a fine month.

SELBORNE.—T and L at 7 p.m. on 2nd; H at 1 p.m. on 3rd; T and L and high wind at 7 p.m. on 4th. A fine summer's day on 27th; ther. in shade 73°. The ther. max. during the nine days from the 20th to the 28th averaged 66°·5; a sudden fall in the temperature took place from the highest, on the 27th—73°, to the lowest, on the 30th—27°·5. Wind very high the beginning of the month, chiefly from S.W.; the last week mostly N.E. Blossoms on fruit trees most abundant, and spring flowers unusually early. (As a general rule I find that there is frost on the grass whenever the temperature 4 feet above it falls to 34°·5.)

BANBURY.—Singular yellow gloom on 12th. Apples in bloom on 15th; hawthorn first in bloom on 19th. Last twelve days of the month very warm and dry, with S.E. winds.

CULFORD.—An exceedingly dry month; high wind on 2nd. On the 19th the weather became suddenly warm, with wind from S.W.; the max. temperature, 74°, occurring on 21st; on the 25th the wind became easterly, and the weather became again cold, the min. temperature, 24°, occurring on the 29th. Westerly winds prevailed during twenty days, and easterly during ten days, the latter occurring at the end of the month. The average temperature of the month was 49°·4. The nightingale was heard here as early as the 5th, swallows were seen on the 21st, and the cuckoo was first heard here on the 27th.

BRIDPORT.—The first half of the month was remarkable for heavy gales, and the variations in the bar. On the 2nd, heavy gale all day, and from 10 p.m. to 3 a.m. furious gale, with T and L. 3rd and 4th, gales. Swallows seen on the 1st, cuckoo heard on 16th; oak in leaf on 22nd, lilac and chesnut in bloom on 23rd, May on 27th, laburnum on 30th.

BODMIN.—Mean temperature of the month 54°·1, being 3°·4 above the average.

SHIFNAL.—The stormy weather with which March closed lasted till the 4th inclusive. R fell (excepting the 1st and 3rd) on the first twelve days, from which day, with the exception of the 17th and 18th, it continued dry to the end. The nights were cold, with frequent frosts, and the day temp. scarcely ever exceeded 55° till the 21st, when a sudden rise to 70° took place, the difference between the night and day temp. being 30°; this lasted to the 29th, when cold easterly winds set in, W. and N.W. having previously prevailed. Damson in blossom on 3rd, wild cherry on 9th and pear tree in blossom on 17th; sand martins seen on 10th, chiff chaff heard on 11th, cuckoo heard on 24th, and landrail on 26th; white butterfly seen on 14th; first queen wasp seen on 20th.

ORLETON.—The first half of the month cold and rainy, with frequent frosts; from the 15th to the end of the month generally very bright, warm, and pleasant. Violent wind on the 2nd; distant T heard on 10th and 13th, and L seen on the latter day. A solar halo at 5 p.m. on the 28th. The mean temp. about 2°·4 above the average of the month. Cuckoo generally heard on 22nd, chiff chaff first seen on 16th, swallows and white throat on 21st; damson trees in full blossom on 7th, and early cherry trees about the 12th.

WIGSTON.—Wind stronger than usual for April during the first ten days or fortnight, since which the temperature has ranged high, with great calm-

ness. Vegetation was more forward at the end of the month that I ever remember it; more leaf on the oak than has frequently been on the 29th May; corn looking well.

GRIMSBY.—Very dry month. The rainfall of the last six months only 5·61, nevertheless the thorough pulverization of the soil by frost in winter has in a wonderful degree retained its moisture. Pastures and corn crops looking very well. High wind on 1st, 2nd, and 3rd; distant T heard on 12th; first swallow seen on 21st; max. temperature of month, 72°, on the same day; apple trees began to blossom on 23rd; willow warbler arrived on 24th; cuckoo heard on 26th.

MANCHESTER.—The month of April had a rainfall greatly below the average, and the latter half of the month was marked by very excessive temperature for the season.

NORTH SHIELDS.—Apple, pear, and currant trees in blossom on 29th.

WALES.

HAVERFORDWEST.—Very heavy weather during the first four days, terrible gale on 2nd and 3rd, with sad casualties round the west coast. One vessel, 2000 tons burthen, totally wrecked near the Smalls lighthouse twenty miles off St. David's Head; all souls lost; the vessel drifted in keel uppermost. The force in this gale between 11 and 12. Heavy weather again about the 14th; after this date the wind shifted easterly, and no rain of importance fell. A remarkable period of heat like Midsummer from 24th to 29th; less frost than usual.

CEFNFAES.—The month fine; no R after the 18th; slight frosts at night; wind S.E. and N.W. Cuckoo heard on the 20th.

LLANDUDNO.—After the first two days a remarkably dry month. A swallow seen on Good Friday, and Cuckoo heard on 24th. S on distant hills from 3rd to 17th. Monthly rose and lilac in flower on 16th; hawthorn on 19th; horse chesnut on 25th, and laburnum on 27th.

SCOTLAND.

DUMFRIES.—The month opened stormy, with S on the hills, and the first half of the month showery and cold, but the latter half very fine; and after the 18th vegetation made great progress; fruit trees in blossom, and a great display of bloom. T on 23rd and 26th; S on 1st and 4th. Rainfall above the average; temp. also above the average. Cuckoo heard on 23rd; swallow very rare.

SILVERBUT HALL.—Very stormy winds on 1st, 2nd and 3rd, and hills covered with S till the 5th. The rainfall on the 2nd was 1·08 in., which brought out the Teviot in full flood. T in the E. in the afternoon of 11th; sharp frosts on the nights of the 22nd, 26th and 29th. There has not been such an appearance for fruit seen here for many years—every tree and bush is literally covered with blossom.

ANNANHILL.—Principal winds W. and S.W., usually light and moderate. On 2nd S.W. gale, 56 miles an hour with heavy squalls of R and wind; rest of month calm. Ozone scarce; a few frosty mornings during the month, but on the whole fine, and favourable for out-door work; usually dry, and land in good condition for sowing and planting, the high temp. having brought fruit blossoms and foliage of all kinds very forward; pastures abundant. Health statistics much more favourable.

CASTLE TOWARD.—The first half of the month dull and wet; but from the 17th it was in every way favourable for out-door work; the clearing of ground for green crops well advanced; potato planting uninterrupted. The grasses and wheat look well; every appearance of an abundant supply of fruit.

NOOKTON.—2nd and 3rd, stormy, on the latter day TS.

BRAEMAR.—A genial month; vegetation and agricultural work in a very forward state—two weeks more forward than usual.

ABERDEEN.—Mean bar. and rainfall below the average; mean temp. 2°·9 above it. A month of very fine, mild, dry weather. S.W. and N.W. winds more prevalent than usual.

PORTREE.—The early part of the month cold and stormy, the latter part fine. Seed sowing and potato planting nearly finished. Cattle and sheep healthy and thriving well.

LOCHBROOM.—The first portion of the month stormy, but from the middle the weather bacame as mild and genial as could be wished. A finer lambing season we never remember, the consequence is that very few losses have occurred, even in these highland wilds.

SANDWICK.—April has been rather warmer than the average; the first three days were very stormy and rather wet, but the latter part was dry and favourable for agricultural operations. The red flowering currant and gooseberry were in flower on the 4th. Hills white with snow on the 17th; aurora on three nights.

IRELAND.

DARRYNANE ABBEY.—Heavy gale on night of 2nd; 6th to 12th moderate westerly winds. Hurricane on the 13th, commencing at S.W., and veering by N.W. to N.; squalls terrific, and awful sea; such a storm has not been known here for years; those who remember the storm of January, 1839 say this was quite as bad. Remainder of the month light variable winds; 26th to the end very fine. H on 3rd 4th, and 5th; frost on 11th and 12th.

MONKSTOWN.—An unusually warm, genial month, especially the latter half.

BALLYSHANNON.—The month on the whole has been a fine one, and favourable for agricultural pursuits, vegetation has made considerable advances, and the summer promises to be a fine one. Easterly winds prevailed during the greater part of the month. At 6·30 p.m. on 21st a gale of unusual violence swept across the bay from S.S.W., duration about two hours.

WARINGSTOWN.—A remarkably dry and warm month.

OMAGH.—First fortnight extremely raw, cold, and unsettled; farming operations almost at a standstill; third week finer, fourth week remarkably fine and warm, causing great vegetation.

BOOKS RECEIVED.

AUSTRIA.

Bericht uber die Verhandlungendes internationalen Meteorologen.—Congreses zu Wien. Vienna, 1873; 8vo.

Jelinek, Dr. C. Jahrbucher der K.K. Centralanstalt fur Meteorologie und Erdmagnetismus. Jahrgang, 1871. 4to, Vienna, 1873.

BARBADOES.

Rawson, The Hon. R. W., Rainfall Returns and Diagrams. Oct., 1873—Mar., 1874.

DENMARK.

Bulletin Météorologique du Nord, publié par les Insituts météorologiques de Norvége, de Danemark et de Suède. Oblong 4to. Jan.—March, 1874.

Hoffmeyer N., Vejledning til Benyttalsen af det Meteorologiotre Instituts daglige Vejrmeddelelser. Copenhagen: George Chr. Ursins Efterfolger, 1873; 4to.

Hoffmeyer Capt., L'Instituts Météorologique Danois. Daily observations November and December, 1873; oblong 4to.

FRANCE.

Annuaire de la Société Météorologique de France, 1872. 8vo.

Annuaire Météorologique et Agricole de l'Observatoire de Montsouris. Pour l'an 1874.

Belgrand M. E., et Lemoine M. G. Observations sur les cours d'eau et la pluie.

Lemoine M. G. and Belgrand M. E. Résumé des Observations centralisées par le service Hydrométrique du bassin de la Seine, 1871—2.

Poey A., sur les rapports entre les taches solaires et les ouragans des Antilles, &c.; 4to.

GREAT BRITAIN.

Aldridge E. G., Temperature and Rainfall at Ventnor, 1852-1873; single sheet, 4to.
Airy Sir G. B., Greenwich Observatory Magnetical and Meteorological Observations, 1871; 4to.
Buchan, A., F.R.S.E., On the Destruction of Seedling Ash Trees by Frost near Edinburgh in April, 1873.
Croll, James. On Ocean Currents. Part III. On the Physical Cause of Ocean Currents. [Excerpt from Phil. Mag. 8vo.]
Dines, G. Diagram of the Rainfall in the London District during 60 years, 1813-72.
Everett, Prof. J, D., M.A., D.C.L. On Mirage. [From Proceedings of the Belfast Nat. Hist. Society.] 8vo., 1874.
Fenland Meteorological Circular. Edited by S. H. Miller, F.R.A.S., F.M.S. Nos. I. and II. Feb. and March. 4to.
Glaisher J. W. L.. Report of Committee on Mathematical Tables [British Association Report]; 8vo.
Kew Committee, Report of, for the year ending October 31st. 1873 [Proc. Roy. Soc.]; 8 vo.
Mackenzie J. Ingleby, Meteorology of Sidmouth in 1872 [Transactions Devonshire Association, 1873]; 8 vo.
Marlborough College. Report of the Nat. Hist. Society, 1874. 8vo.
Meteorological Committee Quarterly Weather Report, Oct- to Dec., 1872; 4to.
Ditto ditto ditto Jan. to March, 1873; 4to.
Morgan, T. M. On a Source of Error in Mercurial Thermometers. [From Proc. Lit. and Phil. Soc., Manchester] Vol. XIII. No. 7. Session 1873—4.
Report of the Proceedings of the Meteorological Congress at Vienna. Translated by order of the Met. Com. London, Stanford, 1874. 8vo.
Rugby School. Report of the Nat. Hist. Soc., 1873, 8vo. 1874.
Silver, S. W., & Co. Australia and New Zealand. Small 8vo. 1874.
Stevenson, R. L., Thermal Influence of Forests [Proceedings Royal Society Edinburgh]; 8 vo.
Sykes, E. J., Report of the Devonshire Hospital for the year 1873; 8 vo.
Wheeler Rev. R. F., and Hoppell Rev. R., Tyneside Naturalists' Field Club Report for 1872 [Natural History Trans., Northumberland]; 8 vo.

HOLLAND.

Ballot, Dr. B. Nederlandsch Meteorologisch jaarbock voor 1873. Oblong 4to. Utrecht, 1873.

ITALY.

Ragona, Prof. D. Sulle variazioni non periodiche della Pressione atmosferica. Folio. Roma, 1874.

MAURITIUS.

The Overland Commercial Gazette, April 4th, 1874.

NEW ZEALAND.

Abstract of Meteorological Observations, New Zealand. Jan-—Nov., 1873.

PRUSSIA.

Karsten, G. Ueber die wissenschaftliche der Ostsee und Nordsee. [Excerpt Poggendorff's Annals].
Karsten, G. Tafeln zur Berechnung der Beobachtungen an den Küsten-Stationen und zur Verwandlung der angewendeten Maasse in Metrisches Maass. Small 8vo. Kiel, 1874.
Karsten, G. Ergebnisse der Beobachtungs stationen an den deutschen Küsten über die physikalischen Eigenschaften der Ostsee und Nordsee und die Fischerei, Jan. and Feb., 1873. Oblong 4to. Berlin, 1874.

UNITED STATES.

Journal of the Telegraph. No. 146 and 150—155.